

REMARKS

The Office Action mailed November 17, 2008, and made final, has been carefully reviewed and the foregoing amendment has been made in consequence thereof.

Claims 1-19 are now pending in this application. Claims 1-7 stand rejected. Claims 8-19 have been withdrawn by the Examiner from further consideration.

The rejection of Claims 1-7 under 35 U.S.C. § 103(a) as being unpatentable over Randolph, Jr. et al. (U.S. Pat. No. 6,453,211) ("Randolph") in view of Applicants' Admitted Prior Art ("AAPA") and further in view of Burke et al. (U.S. Pat. No. 6,508,000) ("Burke"), Flowers et al. (U.S. Patent No. 6,912,446) ("Wang") and Flowers et al. (U.S. Patent No. 6,084,196) ("Flowers") is respectfully traversed.

Randolph describes a method of repairing blades (12b) of a blisk (12). The method includes cutting away bend damage (32) of a blade (12b) to form a cutout (46) at a leading edge (42) of blade (12b). Cutout (46) is then filled with weld material, or an insert-welded metallic spade, to form a weld repair (48) that is larger than a nominal configuration of the blade (12b). Randolph also describes that "[i]n a recent development program, the weld repair of titanium blisk for a gas turbine compressor application is being explored. Damage to the relatively thin leading or trailing edges of an individual blade may be repaired by removing the damaged portion and weld repairing the remaining cutout." (See, col. 2, lines 14-19). Notably, Randolph does not describe nor suggest a repair method that includes depositing a single bead of titanium weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process. Moreover, Randolph does not describe nor suggest a repair method that includes removing a determined portion of titanium alloy material from along leading and trailing edges of the airfoil, and along an entire edge area of a radially outer tip of the airfoil to form respective leading edge, trailing edge, and tip cut-backs.

AAPA describes an exemplary method of repairing a turbine compressor blade by mechanically removing a worn and/or damaged tip area, and adding a material deposit to the tip area to reform the area to the desired dimension. Notably, AAPA does not describe nor suggest a repair method that includes determining an airfoil reparability limit, wherein the limit defines a maximum chord reduction and a minimum blade thickness, determining a

portion of titanium alloy material to be removed based on the determined airfoil reparability limit, removing the determined portion of titanium alloy material from along leading and trailing edges of the airfoil, and along an entire edge area of a radially outer tip of the airfoil to form respective leading edge, trailing edge, and tip cut-backs. Further, AAPA does not describe nor suggest a method that includes depositing titanium a single bead of weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process.

Burke describes a method for repairing airfoil blades (3, 18, and/or 42) along a leading, a trailing edge, or a tip. A portion of the airfoil (3, 18, and/or 42) is removed and replaced with a *pre-formed insert* (1). More specifically, the insert (1) is shaped as an arc segment and is transient liquid phase bonded to the original airfoil (3, 18, and/or 42). To perform the transient liquid phase bonding, the insert (1) must be crystallographically and structurally aligned with the original airfoil (3, 18, and/or 42) to avoid forming discontinuities across a bond line. More specifically, the insert (1) must have the same grain/crystal size, alignment, and/or orientation as the original airfoil (3, 18, and/or 42). Notably, Burke does not describe nor suggest a repair method that includes depositing a single bead of titanium weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process. Moreover, Burke does not describe nor suggest a repair method that includes removing a determined portion of titanium alloy material from along leading and trailing edges of the airfoil, and along an entire edge area of a radially outer tip of the airfoil to form respective leading edge, trailing edge, and tip cut-backs.

Wang describes a method for repairing an airfoil. The method includes creating a nominal numerically-controlled tool path based on a nominal shape of the airfoil, measuring the airfoil using a displacement sensor, and capturing differences in the airfoil shape as compared to the nominal shape. The method further includes creating a three-dimensional map by synchronizing x, y and z coordinates and readings from the sensor, modifying the tool path based on the three-dimensional map, and machining the airfoil. Furthermore, the method includes *welding a plate to the airfoil to cover the damaged portion of the blade*, wherein the plate and welding material may be fabricated from the same material as the blade. Notably, Wang does not describe nor suggest a repair method that includes depositing a single bead of titanium weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process. Moreover, Wang does not describe nor suggest

a repair method that includes removing a determined portion of titanium alloy material from along leading and trailing edges of the airfoil, and along an entire edge area of a radially outer tip of the airfoil to form respective leading edge, trailing edge, and tip cut-backs.

Flowers describes a method for welding a nickel-base superalloy article. The method includes providing a nickel-base superalloy article and a plasma-transferred arc welder, and applying a weld overlay of the filler metal using the plasma-transferred arc welder to a portion of the article concurrently with a step of heating the article to a welding temperature of from about 1650° F. to about 2000° F. Notably, Flowers does not describe nor suggest a repair method that includes depositing a single bead of titanium weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process. Moreover, Flowers does not describe nor suggest a repair method that includes removing a determined portion of titanium alloy material from along leading and trailing edges of the airfoil, and along an entire edge area of a radially outer tip of the airfoil to form respective leading edge, trailing edge, and tip cut-backs.

Claim 1 recites a method of repairing a gas turbine engine compressor blade airfoil that includes “determining an airfoil reparability limit, the limit defining a maximum chord reduction and a minimum blade thickness . . . determining a portion of titanium alloy material to be removed based on the determined airfoil reparability limit . . . removing the determined portion of titanium alloy material from along leading and trailing edges of the airfoil, and along an entire edge area of a radially outer tip of the airfoil to form respective leading edge, trailing edge, and tip cut-backs which each define cut-back depths, wherein the edge area extends from the leading edge to the trailing edge . . . depositing a single bead of titanium weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process . . . and removing at least some of the titanium weld material to obtain pre-desired finished dimensions for the leading and trailing edges, and radially outer tip.”

No combination of Randolph, AAPA, Burke, Wang and Flowers describes nor suggests a method of repairing a gas turbine engine compressor blade airfoil as is recited in Claim 1. More specifically, no combination of Randolph, AAPA, Burke, Wang and Flowers describes nor suggests a repair method that includes depositing a single bead of titanium weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process. Rather, in contrast to the present invention, Randolph describes removing

damaged leading and trailing edge portions of a titanium blisk and weld repairing the blisk, AAPA is only recited for describing removing a damaged tip area and adding a material deposit to only that portion of the tip area, and Burke describes a pre-formed insert that is transient liquid phase bonded to an airfoil to create a bond with a uniform microstructure and chemical composition. Moreover, Wang is only recited for describing that welding material may be fabricated from the same material as a rotor blade, and Flowers is only recited for describing the use of a plasma-transferred arc welder in blade repair.

Applicants respectfully submit that modifying the teachings of Randolph with the teachings of AAPA, Burke, Wang and Flowers does not describe or suggest all of the elements recited in Claim 1. Specifically, modifying the teachings of Randolph with the teachings of AAPA, Burke, Wang and Flowers does not describe or suggest suggests a repair method that includes depositing a single bead of titanium weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process. Moreover, Burke requires the removal of titanium from a bonding foil to avoid formation of deleterious gamma prime eutectics at a bond line. As such, Applicants respectfully submit that it would not have been obvious to one skilled in the art to combine the titanium blisks of Randolph with non-titanium bonding foil of Burke. Rather, Applicants submit that the combination of Randolph and AAPA with Burke, Flowers and Wang would not result in a method that includes depositing titanium weld material onto the leading edge, trailing edge, and tip cut-backs using an automated plasma-arc weld process, as is required by Applicants' claimed invention. Accordingly, for at least the reasons set forth above, Claim 1 is submitted to be patentable over Randolph in view of AAPA, Burke, Wang and Flowers.

Claims 2-7 depend, directly or indirectly, from independent Claim 1. When the recitations of Claims 2-7 are considered in combination with the recitations of Claim 1, Applicants submit that dependent Claims 2-7 likewise are patentable over Randolph in view of AAPA, and further in view of Burke, Wang and Flowers.

For at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 1-7 be withdrawn.

In view of the foregoing amendment and remarks, all the claims now active in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited.

Applicants do not believe any fees are due in connection with this amendment; however, the Commissioner is hereby authorized to charge any fees which may be required to Deposit Account No. 012384 in the name of ARMSTRONG TEASDALE LLP.

Respectfully Submitted,

A handwritten signature in black ink, appearing to read 'William J. Zychlewicz', with a stylized flourish at the end.

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